

### REMARKS

The above amendments to the above-captioned application along with the following remarks are being submitted as a full and complete response to the Office Action dated May 24, 2005. In view of the above amendments and the following remarks, the Examiner is respectfully requested to give due reconsideration to this application, to indicate the allowability of the claims, and to pass this case to issue.

#### Status of the Claims

Claims 1 and 3-6 are under consideration in this application. Claims 7-20 are being cancelled without prejudice or disclaimer. Applicants hereby submit that no new matter is being introduced into the application through the submission of this response.

#### Prior Art Rejections

Claims 1, and 3-5 were rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Pat. No. 5,686,172 to Ohya et al. (hereinafter "Ohya") in view of U.S. Pat. No. 6,337,513 to Clevenger et al. (hereinafter "Clevenger"), and claim 6 was rejected under 35 U.S.C. §103(a) as being unpatentable over Ohya and Clevenger in view of U.S. Pat. No. 4,914,551 to Anshel (hereinafter "Anshel") These rejections have been carefully considered, but are most respectfully traversed.

The semiconductor device 1 having a heat spreader 2 of the invention, as now recited in claim 1, comprises a diamond-containing material having a thermal conductivity  $t$ , where  $350 \leq t < 1000 \text{ W/(m}\cdot\text{K)}$ . The heat spreader 2 is directly disposed entirely or partially on the reverse surface of the semiconductor device 1. The diamond-containing material is (1) a composite of a diamond layer and a ceramic layer or (2) a mixture of diamond particles and ceramic particles, wherein the ceramic layer or the ceramic particles comprises at least one of silicon carbide and aluminum nitride.

The invention, as now recited in claim 5, is also directed to a semiconductor package accommodating the semiconductor device having a heat spreader recited in claim 1, a metal heat sink or a metal radiating fin bonded on a surface of the heat spreader facing away from the semiconductor device.

Although diamond has a thermal conductivity of up to 2200 W/(m·K), just using diamond will significantly increase manufacturing costs. Therefore, the invention combines diamond with ceramics such as SiC and AlN (p. 10, lines 9-13) to provide a heat spreader

with a sufficient high thermal conductivity  $t$ , where  $350 \leq t < 1000$  W/(m·K). The  $t$  of the combination/mixture therefore ranges above AlN's thermal conductivity of 200 W/(m·K) and SiC's thermal conductivity of 270 W/(m·K) (p. 10, lines 19-21), and below 1000 W/(m·K) (Table 1 of Clevenger).

Applicants contend that none of the cited prior art references teaches or suggests such a "(1) composite of a diamond layer and a ceramic layer or (2) mixture of diamond particles and ceramic particles, the ceramic layer or the ceramic particles comprising at least one of silicon carbide and aluminum nitride providing having a thermal conductivity  $t$ ,  $350 \leq t < 1000$  W/(m·K)" as does the invention.

Contrary to the Examiner's assertion (p. 3, lines 3-4 of the outstanding Office Action), Ohya fails to disclose any semiconductor device having a heat spreader comprising a diamond-containing material including a diamond layer or a mixture of diamond particles. The ceramic broad described in col. 5, lines 3-20 of Ohya (p. 4, lines 1-3 of the outstanding Office Action) does not include any diamond layer or any mixture of diamond particles, the powers in the inorganic power described in col. 9, lines 10-15 of Ohya contains only aluminum nitride, etc, but not any diamond layer or any mixture of diamond particles. Ohya, at most, merely mentions various kinds of diamond cutters for slicing a resin-impregnated inorganic continuously porous sintered body (I)(col. 13, lines 16-28; col. 43, line 5). In other words, Ohya's ceramic broad is made of aluminum nitride, etc. with a thermal conductivity of 200 W/(m·K), rather than a combination/mixture of diamond and SiC/AlN with a thermal conductivity  $t$ ,  $350 \leq t < 1000$  W/(m·K).

Clevenger merely forms each of the diamond thin film layers of diamond *or* diamond-like materials, for example diamond-like carbon or silicon carbide (col. 3, lines 11, "*Each of the foregoing structures are preferably fabricated of diamond or diamond-like materials, for example diamond-like carbon or silicon carbide (hereinafter collectively referred to as "diamond").*" 18-20). In other words, Clevenger's diamond thin film layer is made of either diamond with a thermal conductivity between 1000-2000 W/(m·K), or diamond-like carbon (DLC), or SiC with a thermal conductivity of 270 W/(m·K), rather than a combination/mixture of diamond and SiC/AlN with a thermal conductivity  $t$ ,  $350 \leq t < 1000$  W/(m·K).

Anschel fails to compensate for the deficiencies of Ohya and Clevenger. Anschel's heat spreader 37 was selected from silicon carbide, aluminum nitride *or* copper-clad Invar materials (col. 3, lines 48-50), but not any combination/mixture thereof. In addition, Anschel's election of materials was based upon coefficients of thermal expansion (col. 3, lines 53), rather than a

thermal conductivity of the combination/mixture as does the invention.

Applicants further contend that it is not obvious for one skilled in the art to combined Clevenger's diamond material into Ohya's ceramic broad as suggested by the Examiner (p. 3, 3<sup>rd</sup> full paragraph of the outstanding Office Action), since none of the references teaches or suggests combining or mixing diamond and SiC/AlN.

"It is never appropriate to rely solely on "common knowledge" in the art without evidentiary support in the record, as the principal evidence upon which a rejection was based. *In re Zurko*, 258 F.3d 1379, 1385, 59 USPQ2d at 1697 (Fed. Cir. 2001) ("[T]he Board cannot simply reach conclusions based on its own understanding or experience-or on its assessment of what would be basic knowledge or common sense. Rather, the Board must point to some concrete evidence in the record in support of these findings."). As the court held in *Zurko*, an assessment of basic knowledge and common sense that is not based on any evidence in the record lacks substantial evidence support. *Id.* at 1385, 59 USPQ2d at 1697. See also *In re Lee*, 277 F.3d 1338, 1344-45, 61 USPQ2d 1430, 1434-35 (Fed. Cir. 2002) (In reversing the Board's decision, the court stated " 'common knowledge and common sense' on which the Board relied in rejecting Lee's application are not the specialized knowledge and expertise contemplated by the Administrative Procedure Act. Conclusory statements such as those here provided do not fulfill the agency's obligation. The Board cannot rely on conclusory statements when dealing with particular combinations of prior art and specific claims, but must set forth the rationale on which it relies."). " As such the Examiner shall provide "some concrete evidence in the record in support of" factual assertion to rely solely on "common knowledge" in the art as the principal evidence for combining the references in the particular manner as suggested by the Examiner.

Under the current case law and MPEP 2144.03, Applicants hereby respectfully assert that the Examiner should not rely upon the knowledge of one skilled in the art without basing upon concrete evidence in the record, i.e., statements in the prior art, in support of the alleged obviousness (p. 3 lines 5-10 of the outstanding office action) for one skilled in the art to combine Ohya and Clevenger. Applicants invite the Examiner to provide a prior art reference that would provide the motivation for combining the teachings in Ohya and Clevenger.

Although the invention applies diamond, SiC, AlN as disclosed in Ohya, Clevenger or Anshel, the invention applies a combination/mixture of diamond, SiC, AlN to achieve unexpected results or properties, such as to reduce manufacturing costs while providing a thermal conductivity  $t$ , where  $350 \leq t < 1000$  W/(m·K). The presence of these unexpected

properties is evidence of nonobviousness. MPEP§716.02(a).

*“Presence of a property not possessed by the prior art is evidence of nonobviousness. In re Papesch, 315 F.2d 381, 137 USPQ 43 (CCPA 1963) (rejection of claims to compound structurally similar to the prior art compound was reversed because claimed compound unexpectedly possessed anti-inflammatory properties not possessed by the prior art compound); Ex parte Thumm, 132 USPQ 66 (Bd. App. 1961) (Appellant showed that the claimed range of ethylene diamine was effective for the purpose of producing " 'regenerated cellulose consisting substantially entirely of skin' " whereas the prior art warned "this compound has 'practically no effect.' " ).*

Applicants will point out that “[t]he submission of evidence that a new product possesses unexpected properties does not necessarily require a conclusion that the claimed invention is nonobvious. *In re Payne*, 606 F.2d 303, 203 USPQ 245 (CCPA 1979). See the discussion of latent properties and additional advantages in MPEP § 2145.” However, the three unexpected properties were unknown and non-inherent functions in view of Ohya, Clevenger and/or Anschel, since they will not inherently achieve the same results. In other words, these advantages would not flow naturally from following the prior art teachings since they fail to suggest applying a combination/mixture of diamond, SiC, AlN to provide a heat spreader with a thermal conductivity  $t$ , where  $350 \leq t < 1000 \text{ W/(m}\cdot\text{K)}$ .

Applicants further contend that the mere fact that one of skill in the art could rearrange Ohya, Clevenger and Anschel, to meet the terms of the claims is not by itself sufficient to support a finding of obviousness. The prior art must provide a motivation or reason for one skilled in the art to provide the unexpected properties, such as to reduce manufacturing costs while providing a thermal conductivity  $t$ , where  $350 \leq t < 1000 \text{ W/(m}\cdot\text{K)}$ , without the benefit of appellant's specification as a guide to make the necessary changes in the reference device. *Ex parte Chicago Rawhide Mfg. Co.*, 223 USPQ 351, 353 (Bd. Pat. App. & Inter. 1984). MPEP§2144.04 VI C.

Applicants contend that neither Ohya, Clevenger, Anschel, nor their combination teaches or suggests each and every feature of the present invention as recited in at least independent claims 1 and 5. As such, the present invention as now claimed is distinguishable and thereby allowable over the rejections raised in the Office Action. The withdrawal of the outstanding prior art rejections is in order, and is respectfully solicited.

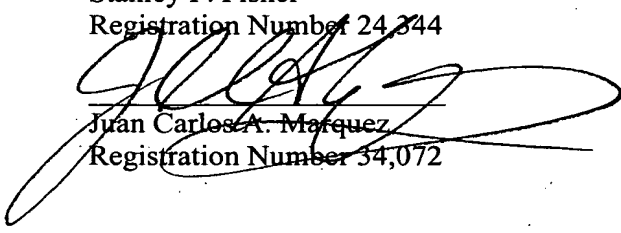
## Conclusion

In view of all the above, clear and distinct differences as discussed exist between the present invention as now claimed and the prior art reference upon which the rejections in the Office Action rely, Applicants respectfully contend that the prior art references cannot anticipate the present invention or render the present invention obvious. Rather, the present invention as a whole is distinguishable, and thereby allowable over the prior art.

Favorable reconsideration of this application is respectfully solicited. Should there be any outstanding issues requiring discussion that would further the prosecution and allowance of the above-captioned application, the Examiner is invited to contact the Applicants' undersigned representative at the address and phone number indicated below.

Respectfully submitted,

\_\_\_\_\_  
Stanley P. Fisher  
Registration Number 24,344

  
\_\_\_\_\_  
Juan Carlos A. Marquez  
Registration Number 34,072

**REED SMITH LLP**  
3110 Fairview Park Drive, Suite 1400  
Falls Church, Virginia 22042  
(703) 641-4200

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